The Lowdown on Open Baths and Heat Transfer Fluids

Nothing puts a heat transfer fluid to the test more than an open bath application. By nature these applications leave the fluid exposed to the atmosphere, resulting in the number one cause of fluid breakdown: oxidation.

An "open" invitation to trouble

In basic terms, oxidation occurs when hot fluid comes in contact with air which forms acidic compounds and ultimately sludge. Sludge is usually found in low flow areas such as reservoirs or expansion tanks or in the case of an open bath, within the bath itself. The hotter the bath temperature, the faster and more severe this reaction is. Very few fluids will hold up under these conditions for more than a few days.

Take precautions

Another consideration in open bath applications is off-gassing. This usually looks like smoke coming from the bath, but it's actually just lighter molecules being released from the fluid as it's heated. These vapors should not be inhaled and regardless of the fluid being used, all baths should have proper ventilation to protect the operator from fumes and off-gassing. And remember: as temperatures rise, off-gassing increases so be sure to account for this when planning for ventilation requirements.

So what are my options?

The oxidation and off-gassing that comes with open bath applications will cripple most heat transfer fluids, so it's important to choose one that will stand up in these conditions. Duratherm has two fluids that are well-suited to open baths: Duratherm S and Duratherm G.

Duratherm G is a polyalkylene glycol based fluid suitable for temperatures up to 500°F (260°C). While Duratherm G is susceptible to oxidation it does not have the tendency to form sludge as a result. Off-gassing is moderate at lower temperatures but fairly high as you reach its limit of 500°F. This fluid should also be monitored regularly for high acid levels. The acids typically formed through oxidation are generally mild and non-corrosive. However, if Duratherm G is left unchecked these acids can get to the level where they could start to become corrosive. Duratherm offers a free fluid analysis to ensure you stay well below these conditions.

Duratherm S is a Polydimethylsiloxane (silicone) based fluid that offers extreme resistance to oxidation up to 400°F (204°C). At temperatures above 400°F however, Duratherm S or any Polydimethylsiloxane based fluid will gel if exposed to air and the higher the temperature the faster it will convert from a liquid to a gel. For example the service life of Duratherm S will be approximately one year when operating at 350°F. Operating just above 400°F will reduce the service life to 300 hours and at 600°F, the fluid will only last 24 hours.

There are other options available in the marketplace. A close cousin to Polydimethylsiloxane, Phenylmethylsiloxane does offer higher temperature/oxidation stability and a longer service life but it's a lot more expensive than fluids like Duratherm S. Fluorinated fluids such as those from Galden and 3M - although very expensive - can be used in bath applications as well.

The final word

We hope this article has shed some light on the special challenges that come open baths and heat transfer fluids. These are demanding applications that require special safety considerations. They also amount to a bit of a trade-off between cost and service life.